SECTION 3.0 ALTERNATIVES DESCRIPTION AND COMPONENTS

The section describes the four alternatives and their components. Each alternative description is divided into the following elements:

- Anticipated Wastewater Treatment Facility (WWTF) Upgrade Requirements – This summarizes the anticipated upgrades for each WWTF to accommodate the year 2025 projected flows and loads. Also described are the anticipated process upgrade requirements to meet the future discharge limits based on the specific discharge locations.

- Anticipated Conveyance Requirements – This summarizes the conveyance components (i.e. pipelines and pump stations) anticipated to convey the treated wastewater from the WWTFs to the discharge location.

- Anticipated Discharge and Disposal Requirements – The anticipated discharge and disposal requirements include any new outfall pipes, pump stations and land disposal methods anticipated for each alternative related to final disposal.

- Other Anticipated Components – This summarizes components that are not included in the categories above but are anticipated for an alternative (decentralized systems, regional disinfection facilities, etc.).

3.1 ALTERNATIVE 1 – NO ACTION

For this alternative, wastewater treatment would continue at each of the 17 WWTFs within the study area, and treated effluent would be discharged at existing surface water discharge locations. Figure 3-1 shows the concept of this alternative.

The No Action alternative has been selected as one of the four alternatives as it sets a baseline for future conditions against which to compare impacts of the other alternatives. The inclusion of a No Action alternative is consistent with requirements for the National Environmental Policy Act (NEPA) process, which may be formally required depending on which alternative(s) may be ultimately implemented. Please note that although this alternative is considered “No Action”, WWTFs would still be required to meet the projected future effluent standards.

3.1.1 Anticipated WWTF Upgrade Requirements

A number of WWTF upgrades are anticipated for this alternative. Some of the upgrades are anticipated as a result of projected 2025 changes in the permit limits for the WWTF. The projected effluent limits for this study are included in Appendix K and Appendix L of the PFR in memos titled *Methodology for Development of Future WWTF Limits* (August 2005) and *Projected 2025 WWTF Discharge Limits* (August 2005), respectively. Other upgrades are anticipated as a result of projected increased flow and loadings to the WWTF and the inability of the existing unit processes to handle the 2025 future flows and loads.

Table 3-1 presents the upgrades anticipated for each WWTF under Alternative 1 and includes the following information:

- Type of Process Upgrade Needed – This includes upgrades for carbon removal, total nitrogen removal, the addition of an activated sludge process, and total phosphorus removal. The various process upgrades also indicate whether the upgrade is anticipated for the incremental flow increase to the WWTF from 2004 to 2025 or for the entire 2025 flow.

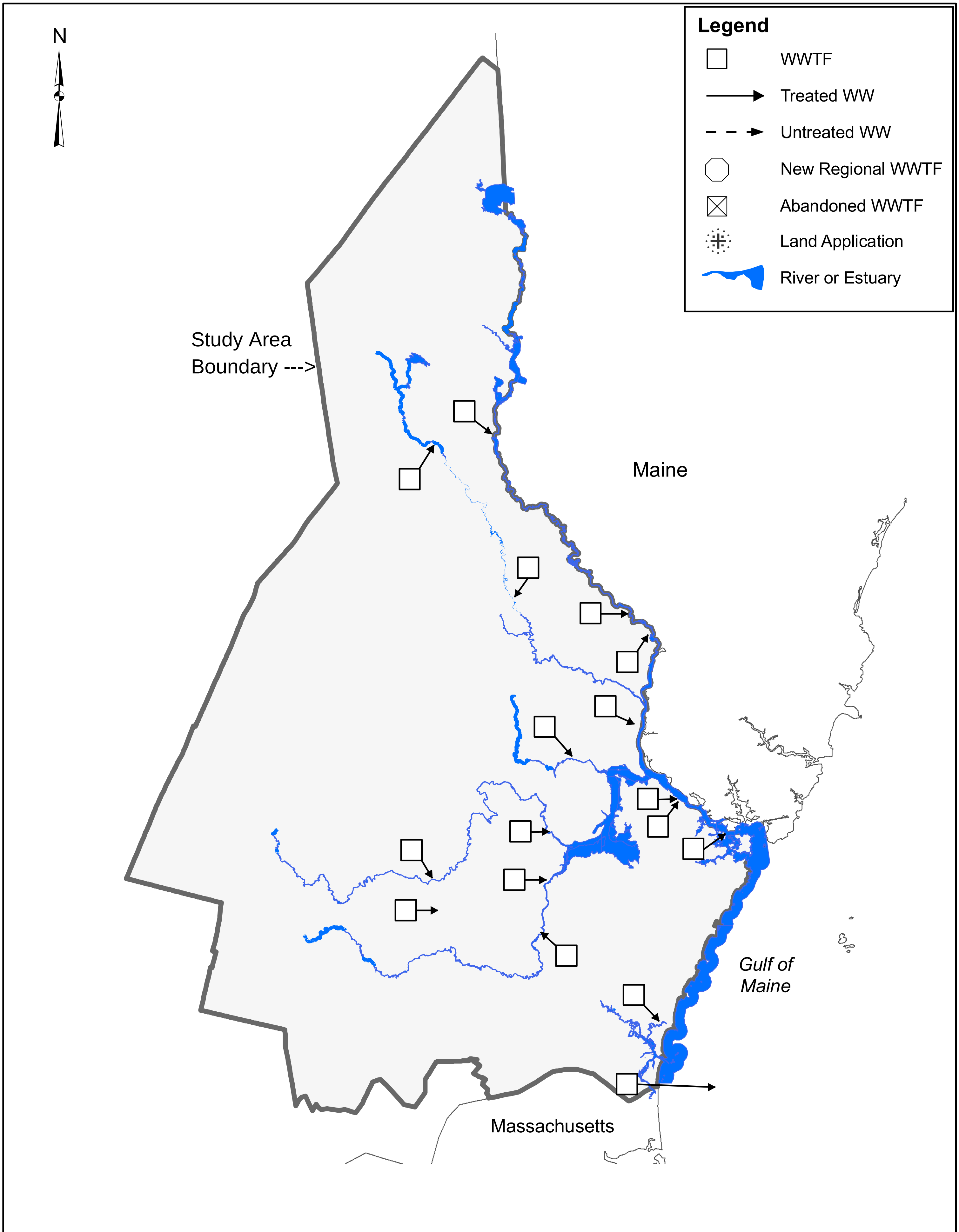

Figure 3-1. Alternative 1 - No Action

Table 3-1. Alternative 1 Anticipated WWTF Upgrade Requirements.

FACILITY	Year 2004 Max Mo. Flow, MGD	Year 2025 Max Mo. Flow, MGD	Upgrades Projected	Incremental Flow Increase, MGD	Carbon Removal Upgrade Anticipated	Carbon Filtration Upgrade Anticipated	Nitrogen Removal Upgrade Anticipated	TP Removal Upgrade Anticipated	Other Upgrades Anticipated
DOVER WASTEWATER	4.57	4.87	C, TN	0.3	yes new flow	no	yes	no	IP, Pre, Dis
DURHAM WASTEWATER	1.71	1.8	TN	0.09	no	no	yes	no	IP, Pre, Dis
EPPING WATER & SEWER	0.32	0.429	C, TN, TP	0.109	yes new flow	no MBR	yes - new flow	new flow chemical only	Pre, Mem, Dis
EXETER WASTEWATER	3.6	3.9	AS, C, TN	0.3	all flow	no	yes	no	Pre
FARMINGTON WASTEWATER	0.52	0.57	C, TN, TP	0.05	yes new flow	no also P	yes	yes	IP, Pre, M
HAMPTON WASTEWATER	3.3	3.7	C, TN	0.4	yes new flow	yes	yes new	no	M, Dis, SH
MILTON WASTEWATER	0.08	0.09	AS, C, TN, TP	0.01	all flow	No for P only	yes	yes	NR
NEWFIELDS WASTEWATER	0.08	0.084	AS, C, TN	0.004	all flow	no	yes	no	NR
NEWINGTON WASTEWATER	0.18	0.2	TN	0.02	no	no	yes	no	NR
NEWMARKET WASTEWATER	1.04	1.16	AS, C, TN	0.12	all flow	no	yes	no	IP, Pre, Dis
PEASE DEVELOPMENT AUTHORITY	0.72	0.86	NR	0.14	no	no	SBR mods only	no	Dis
PORTSMOUTH WASTEWATER	8.23	8.7	AS, C	0.47	all flow	no	no	no	Dis, SH
ROCHESTER WASTEWATER	5.51	6.1	TP	0.59	no	No for P only	yes new flow	new flow	2nd Clarifier
ROCKINGHAM COUNTY WWTF	0.085	0.118	AS, C, TN	0.033	all flow	yes	yes	no	NR
ROLLINSFORD WASTEWATER	0.15	0.17	TP	0.02	no	No for P only	no	yes new flow	NR
SEABROOK WASTEWATER	1.17	1.39	NR	0.22	no	no	no	no	Air
SOMERSWORTH WASTEWATER	1.79	1.9	C, TN, TP	0.11	yes new flow	No for P only	yes new flow	yes new flow	Pre
Totals	**33.06**	**36.04**		**2.99**					

Legend

C = Carbon
TN = Total Nitrogen
TP = Total Phosphorus
AS = Activated Sludge

IP = Influent Pumping
Pre = Preliminary Treatment
Dis = Disinfection
Mem = Membranes

M = Metals
Air = Aeration
SH = Solids Handling
NR= Not Required

- Carbon Removal Upgrades – This includes activated sludge upgrades, additional tankage, or cloth disc filtration for low carbon and total suspended solids limits. In the cases where an activated sludge upgrade is anticipated, it is typically to replace an aerated lagoon or trickling filter system that would not be able to meet the 2025 carbon limits at the 2025 loading. The anticipated activated sludge upgrade requirement may also indicate that the existing WWTF can meet the future carbon limits but cannot meet the total nitrogen limits.

- Total Nitrogen Removal Upgrades – The anticipated requirements for total nitrogen removal upgrades have been standardized to include tankage and process equipment anticipated to implement a Modified Ludzack-Etenger (MLE) process at the WWTFs. This upgrade may include the addition of tankage, installation of internal recycle pumps, and mixers for anoxic zones.

- Total Phosphorus Removal Upgrades – The anticipated requirements for total phosphorus removal upgrades have been standardized to include the addition of cloth disc filters and chemical addition for the removal of total phosphorus.

- Other Unit Process and Equipment Upgrades – Other upgrades are included based on hydraulic limitations or small process upgrades that do not necessitate the construction of additional tankage or separate unit processes. These upgrades include the following:

    - Influent Pumping
    - Preliminary Treatment (screenings or grit removal)
    - Disinfection
    - Membranes – Additional membranes for MBR processes
    - Metals removal evaluation – For WWTFs that have the potential for metals limits in their future permit limits, it has been assumed that a study would be performed in lieu of an upgrade to determine if the permit would include a metals limit.
    - Aeration capacity
    - Solids handling capacity

3.1.2 Anticipated Discharge and Disposal Requirements

For this alternative, the existing WWTF outfalls will be used for disposal.

3.2 ALTERNATIVE 2 – TREATMENT AT EXISTING WWTFs WITH A REGIONAL GULF OF MAINE DISCHARGE

For this alternative, treatment would continue at each of the 17 WWTFs within the study area. Subsequently, the effluent from these WWTFs would be conveyed through new regional infrastructure (e.g. pump stations and pipelines) for discharge to the Gulf of Maine. Figure 3-2 shows the concept of this alternative.

An additional component of this alternative is a Regional Post-Treatment Facility (RPTF). Disinfection at the individual WWTFs will not be performed under this alternative. This is due to the high potential for biological re-growth in the conveyance system as a result of the long conveyance times. Instead of localized disinfection, a RPTF will provide disinfection and sampling of the regionally collected WWTF effluents prior to discharge to the Gulf of Maine Outfall.

This alternative was selected as one of the four alternatives since Senate Bill 70 requires this study to determine the feasibility to remove treated effluent from the coastal drainage area and Great Bay and discharge it through a regional pipe in the Gulf of Maine.

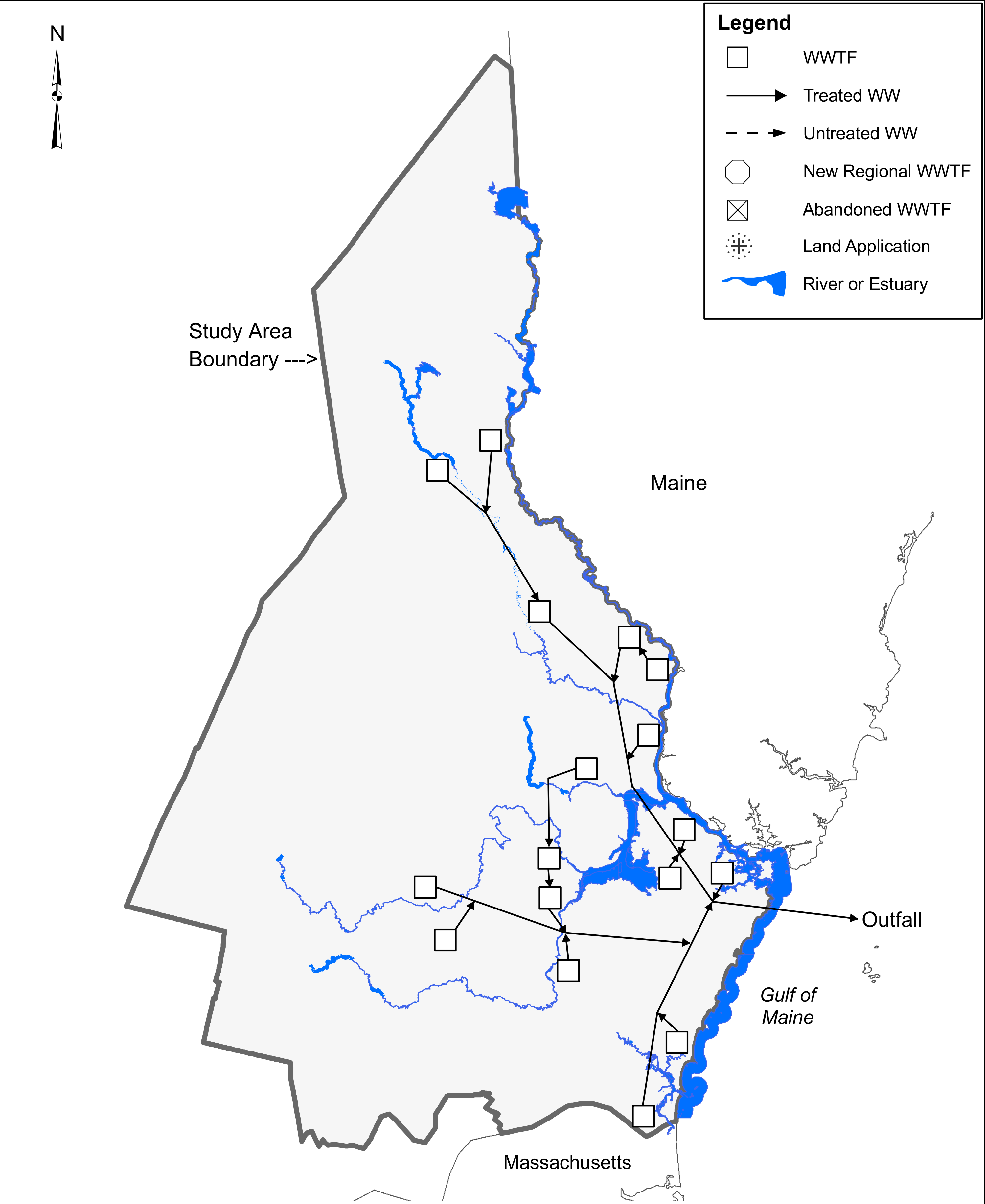

Figure 3-2. Alternative 2 - Treatment at Existing WWTFs with a Regional Gulf of Maine Discharge

3.2.1 Anticipated WWTF Upgrade Requirements

A number of WWTF upgrades are anticipated for this alternative. Some of the upgrades are anticipated as a result of projected 2025 changes in the permit limits for the WWTF. The projected effluent limits for this study are included in Appendix K and Appendix L of the PFR in memos titled *Methodology for Development of Future WWTF Limits* (August 2005) and *Projected 2025 WWTF Discharge Limits* (August 2005), respectively. Other upgrades are anticipated as a result of projected increased flow and loadings to the WWTF and the inability of the existing unit processes to handle the 2025 flows and loads.

Table 3-2 presents the anticipated upgrades required for each WWTF under Alternative 2. The information presented in Table 3-2 is described in Section 3.1.1.

3.2.2 Anticipated Conveyance Requirements

In order to convey the treated effluent from the 17 area WWTFs to one location prior to discharge to a regional outfall, a number of pipelines and pump stations are anticipated to be required. Figure 3-3 shows one possible conveyance route from the 17 WWTFs to the RPTF and ultimately to a Gulf of Maine outfall. It is assumed that all of the WWTF effluent flows will be conveyed via force mains. Force mains will eliminate the use of gravity sewers which need to be installed deeper than force mains, will prevent illegal hook ups to the conveyance system (since all hook ups would need to be pressurized), and will minimize the impact of inflow and infiltration into the conveyance system.

The route shown has been selected to use as many rights-of-way as possible (roads, gas pipeline routes, electrical distribution system routes, etc.) to minimize the quantity of previously undisturbed cross country routes and land acquisition that would be required. It should be noted that the selection of this route is for planning level study purposes only and is not meant to imply that a future conveyance system, if deemed feasible, would follow this routing.

Table 3-3 illustrates some of the anticipated conveyance system components required. It should be noted that these components have been sized to accommodate the average of the projected 2055 peak daily flow and the 2055 peak hourly flow. A fifty year design flow has been selected due to the typical 50 year service life of pipelines. The average of peak day and peak hour was selected due to the anticipated dampening of peak hourly flow through the various unit processes of the WWTFs. These conveyance system components include:

- Pump Stations – It is assumed that a pump station will be required at every WWTF, any place that two conveyance pipelines are joined into one pipeline, and every 10 miles along individual pipe lines. Table 3-3 lists the pump stations and their approximate sizes.

- Pipelines – Table 3-3 provides planning level lengths and sizes of the various conveyance pipelines. The pipelines have been sized to have maximum velocity in the pipelines of 5.0 feet per second at the average of the 2055 peak day flow and the 2055 peak hourly flow. Table 3-3 shows all of the different pipelines that would be anticipated for this routing. Table 3-3 also shows the individual WWTF effluents and the approximate pipeline distances, pipe sizes, and number of pump stations anticipated to combine all of the WWTF flows from their WWTF of origin along the conveyance system.

3.2.3 Regional Post-Treatment Facility

Disinfection at the individual WWTFs will not be performed under this alternative. This is due to the potential for biological re-growth in the conveyance system as a result of the long conveyance times. A Regional Post-Treatment Facility (RPTF) will be provided for disinfection and sampling of the regionally collected WWTF effluent. This facility is assumed to be chlorination and dechlorination facility that will provide a minimum of 30 minutes of chlorine contact time prior

Table 3-2. Alternative 2 Anticipated WWTF Upgrade Requirements.

FACILITY	Year 2004 Max Mo. Flow, MGD	Year 2025 Max Mo. Flow, MGD	Upgrades Projected	Incremental Flow Increase, MGD	Carbon Removal Upgrade Anticipated	Carbon Filtration Upgrade Anticipated	Nitrogen Removal Upgrade Anticipated	TP Removal Upgrade Anticipated	Other Upgrades Anticipated
DOVER WASTEWATER	4.57	4.87	C	0.3	yes new flow	no	no	no	IP, Pre
DURHAM WASTEWATER	1.71	1.8	NR	0.09	no	no	no	no	IP, Pre
EPPING WATER & SEWER	0.32	0.429	C	0.109	yes new flow	no	no	no	Pre, Mem
EXETER WASTEWATER	3.6	3.9	AS, C	0.3	all flow	no	no	no	Pre
FARMINGTON WASTEWATER	0.52	0.57	C	0.05	yes new flow	no	no	no	IP, Pre
HAMPTON WASTEWATER	3.3	3.7	NR	0.4	no	no	no	no	SH
MILTON WASTEWATER	0.08	0.09	C	0.01	yes new flow	no	no	no	NR
NEWFIELDS WASTEWATER	0.08	0.084	C	0.004	yes new flow	no	no	no	Air
NEWINGTON WASTEWATER	0.18	0.2	C	0.02	yes new flow	no	no	no	Air
NEWMARKET WASTEWATER	1.04	1.16	C	0.12	yes new flow	no	no	no	IP, Pre
PEASE DEVELOPMENT AUTHORITY	0.72	0.86	NR	0.14	no	no	no	no	NR
PORTSMOUTH WASTEWATER	8.23	8.7	AS, C	0.47	all flow	no	no	no	SH
ROCHESTER WASTEWATER	5.51	6.1	C	0.59	no	no	no	no	2nd Clarifier
ROCKINGHAM COUNTY WWTF	0.085	0.118	NR	0.033	no	no	no	no	NR
ROLLINSFORD WASTEWATER	0.15	0.17	NR	0.02	no	no	no	no	NR
SEABROOK WASTEWATER	1.17	1.39	NR	0.22	no	no	no	no	NR
SOMERSWORTH	1.79	1.9	NR	0.11	no	no	no	no	Pre, Air
Totals	**33.06**	**36.04**		**2.99**					

<u>Legend</u>

C = Carbon
TN = Total Nitrogen
TP = Total Phosphorus
AS = Activated Sludge
IP = Influent Pumping
Pre = Preliminary Treatment
Dis = Disinfection
Mem = Membranes
M = Metals
Air = Aeration
SH = Solids Handling
NR= Not Required

Table 3-3. Alternative 2 WWTF Effluent Conveyance Components

Pipe Routing and Flow Combining			Conveyance Components and Planning Level Sizing					
From	To	Flow (MGD)	Pipe Length, ft	Pipe Length, Miles	Year 2055 Flow, MGD	Year 2055 Pipe Size, in.	Number of Pump Stations Anticipated	Approximate Pump Station Size, MGD
FARMINGTON WWTF	Northeast Main 1	0.91 MGD	35,000	6.63	0.91	8	1	0.91
MILTON WWTF	Northeast Main 1	0.24 MGD	26,000	4.92	0.24	4	1	0.24
Northeast Main 1	Northeast Main 2	1.15 MGD	20,000	3.79	1.15	10	1	1.15
ROCHESTER WWTF	Northeast Main 2	10.00 MGD	4,000	0.76	10.00	24	1	10.00
Northeast Main 2	Northeast Main 3	11.15 MGD	35,000	6.63	11.15	30	1	11.15
ROLLINSFORD WWTF	Rollinsford Submain 1	0.36 MGD	12,000	2.27	0.36	6	1	0.36
SOMERSWORTH WWTF	Rollinsford Submain 1	5.75 MGD	-		5.75	18	1	5.75
Rollinsford Submain 1	Northeast Main 3	6.11 MGD	19,000	3.60	6.11	20	1	6.11
Northeast Main 3	Northeast Main 4	17.25 MGD	28,000	5.30	17.25	36	1	17.25
DOVER WWTF	Northeast Main 4	12.74 MGD	4,000	0.76	12.74	30	1	12.74
Northeast Main 4	Northeast Main 5	29.99 MGD	30,000	5.68	29.99	42	1	29.99
NEWINGTON WWTF	Northeast Main 5	0.54 MGD	5,000	0.95	0.54	6	1	0.54
PEASE WWTF	Northeast Main 5	3.15 MGD	3,000	0.57	3.15	14	1	3.15
Northeast Main 5	Ocean Outfall Main	33.67 MGD	13,000	2.46	33.67	48	1	33.67
DURHAM WWTF	Durham Submain 1	5.35 MGD	31,000	5.87	5.35	18	1	5.35
NEWMARKET WWTF	Durham Submain 1	2.41 MGD	-		0.69	12	1	2.41
Durham Submain 1	Durham Submain 2	7.76 MGD	14,000	2.65	7.76	24	1	7.76
NEWFIELDS WWTF	Durham Submain 2	0.17 MGD	-		0.17	4	1	0.17
Durham Submain 2	Southeast Inland Main 1	7.928 MGD	8,000	1.52		24	1	7.93
EPPING WWTF	Epping Submain 1	0.70 MGD	9,000	1.70	0.70	8	1	0.70
ROCKINGHAM CO. WWTF	Epping Submain 1	0.44 MGD	4,000	0.76	0.44	6	1	0.44
Epping Submain 1	Southeast Inland Main 1	1.14 MGD	30,000	5.68	1.14	10	1	1.14
EXETER WWTF	Southeast Inland Main 1	6.75 MGD	12,000	2.27	6.75	20	1	6.75
Southeast Inland Main 1	Coastal Submain 2	15.81 MGD	43,000	8.14	15.81	30	1	15.81
SEABROOK WWTF	Coastal Submain 1	3.86 MGD	25,000	4.73	3.86	16	1	3.86
HAMPTON WWTF	Coastal Submain 1	8.60 MGD	6,000	1.14	8.60	24	1	8.60
Coastal Submain 1	Coastal Submain 2	12.46 MGD	42,000	7.95	12.46	30	1	12.46
Coastal Submain 2	Ocean Outfall Main	28.27 MGD	12,000	2.27	28.27	42	1	28.27
Ocean Outfall Main	Post Treatment Facility	61.94 MGD	2,000	0.38	61.94	60	1	61.94
PORTSMOUTH WWTF	Post Treatment Facility	22.00 MGD	8,000	1.52	22.00	36	1	22.00
Post Treatment Facility	Gulf of ME Outfall	**83.94** MGD	22,700	4.30	83.94	72	1	83.94
		Totals	**502,700**	**95.21**			**31**	

Notes:
- All flows in MGD
- All flows are the average of Year 2055 peak hour and peak day flows
- See Figure 3-3 for planning level conveyance routes used to develop this table
- (yellow highlight) - Indicates flow originating from individual WWTFs

Figure 3-3. Potential Effluent Conveyance Route for Alternative 2.

G:\Projects\STATE\36800545GBY\Maps\Great Bay Basemap 03rev.mxd to dechlorination, and subsequent discharge into the Gulf of Maine outfall. At this time a site for a RPTF has not been identified. Its location on Figure 3-3 is not intended to imply that this location is either feasible or infeasible but only to show that the facility is to be located at the downstream terminus of the conveyance system. If Alternative 2 is deemed feasible, then additional studies would need to be performed to identify a suitable site for this facility.

3.2.4 Anticipated Discharge and Disposal Requirements

This alternative would include an outfall to the Gulf of Maine. Some of the components of the outfall would include: the outfall pipe from the RPTF, the outfall diffuser which would consist of a number of diffuser ports spread out along a length of pipe (to increase the dilution of the discharged effluent), and the diffuser ports themselves. Three candidate outfall sites were developed for evaluation. The location of the candidate outfall sites are shown in Figure 3-4, and some of the details of these locations are included in Table 3-4. More detailed information about the candidate outfall site evaluations and designs can be found in Appendix D. These sites were selected to provide a range of distances from shore and water depths. The selection of these sites is for study purposes only and is not intended to indicate the feasibility of those sites.

TABLE 3-4. CANDIDATE OUTFALL DETAILS

Outfall Details	Site 1	Site 2	Site 3
Distance from Shore, miles	4.3	8.0	11.6
Depth at Low Water, ft.	60	120	160
Outfall Length, miles	4.3	15.5	20.0
Outfall Diameter, ft.	6.0	6.0	6.0
Diffuser Design			
Length, ft	1,290	2,580	3,440
Number of Ports	44	44	44
Port Diameter, in.	6.0	6.0	6.0

Depending on the outfall location, as well as the location and elevation of the RPTF, there is the potential that a pump station may be required at the RPTF to provide sufficient head to discharge the effluent through the Gulf of Maine outfall (especially under peak flow and high tide conditions). In general, the further the outfall is away from the RPTF, the greater the chance that a pump station will be required. The head requirements of the different sites at various flow rates are shown in Table 2 of Appendix D. For the purpose of this study, it is assumed that an effluent pump station would be required.

3.3 ALTERNATIVE 3 – DECENTRALIZED TREATMENT AND CONTINUED USE OF EXISTING WWTFs

For this alternative, the existing WWTFs would continue to be used; however, it is assumed that the existing 2004 flow and one-third of the 2025 projected increase in wastewater flow would be treated at the existing WWTFs and discharged at the existing surface water discharge locations. The remaining two-thirds of the projected incremental flow increase would go to decentralized systems for treatment and subsurface land application. Figure 3-5 shows the concept of this alternative.

Specific identification of decentralized system locations will not be conducted as part of this alternative. Although this alternative was not one of the ten preliminary alternatives, it was developed and chosen to be carried forward for further study largely in response to the many comments received requesting that decentralized treatment be included as part of a regional solution.

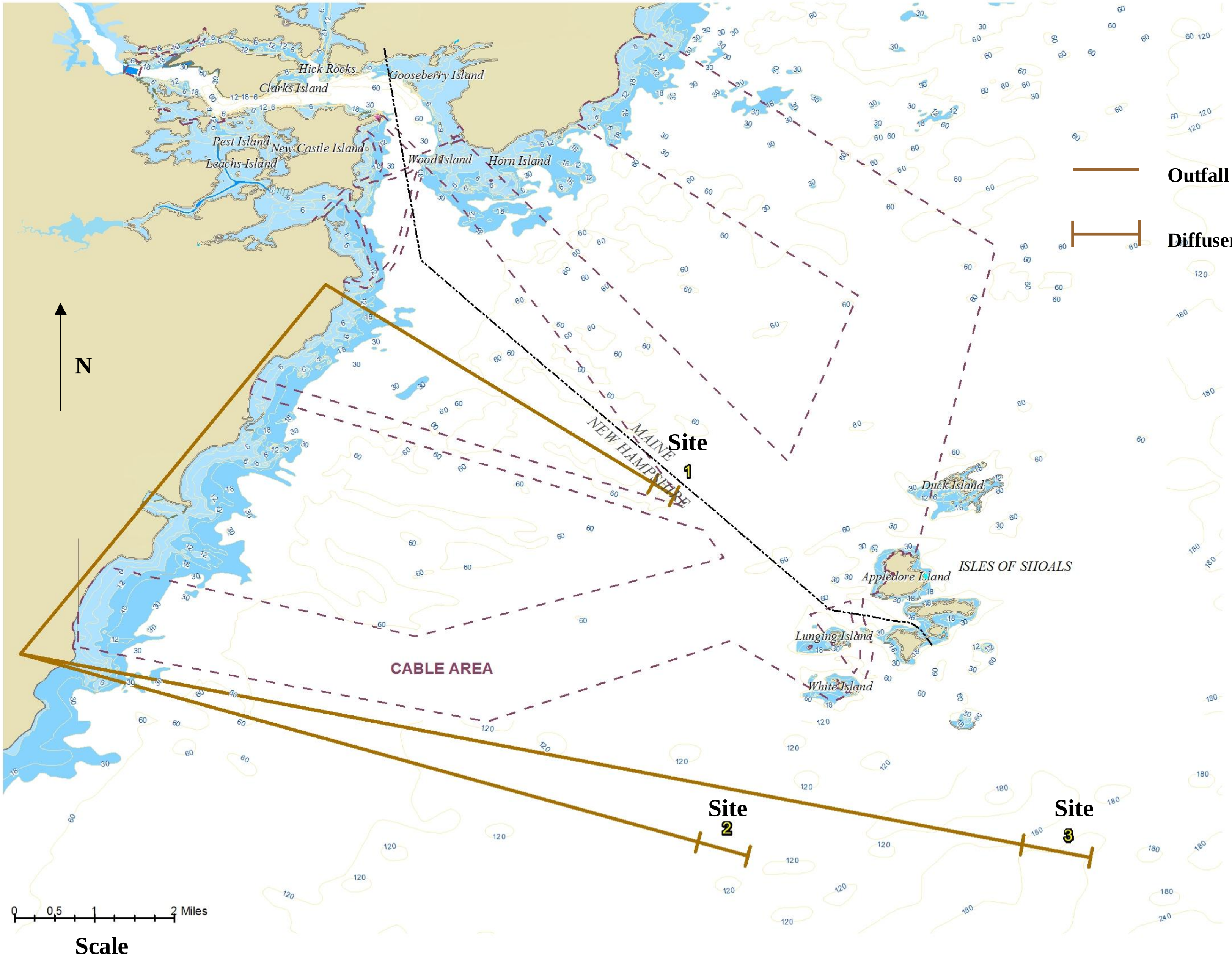

Figure 3-4. Candidate Outfall Sites

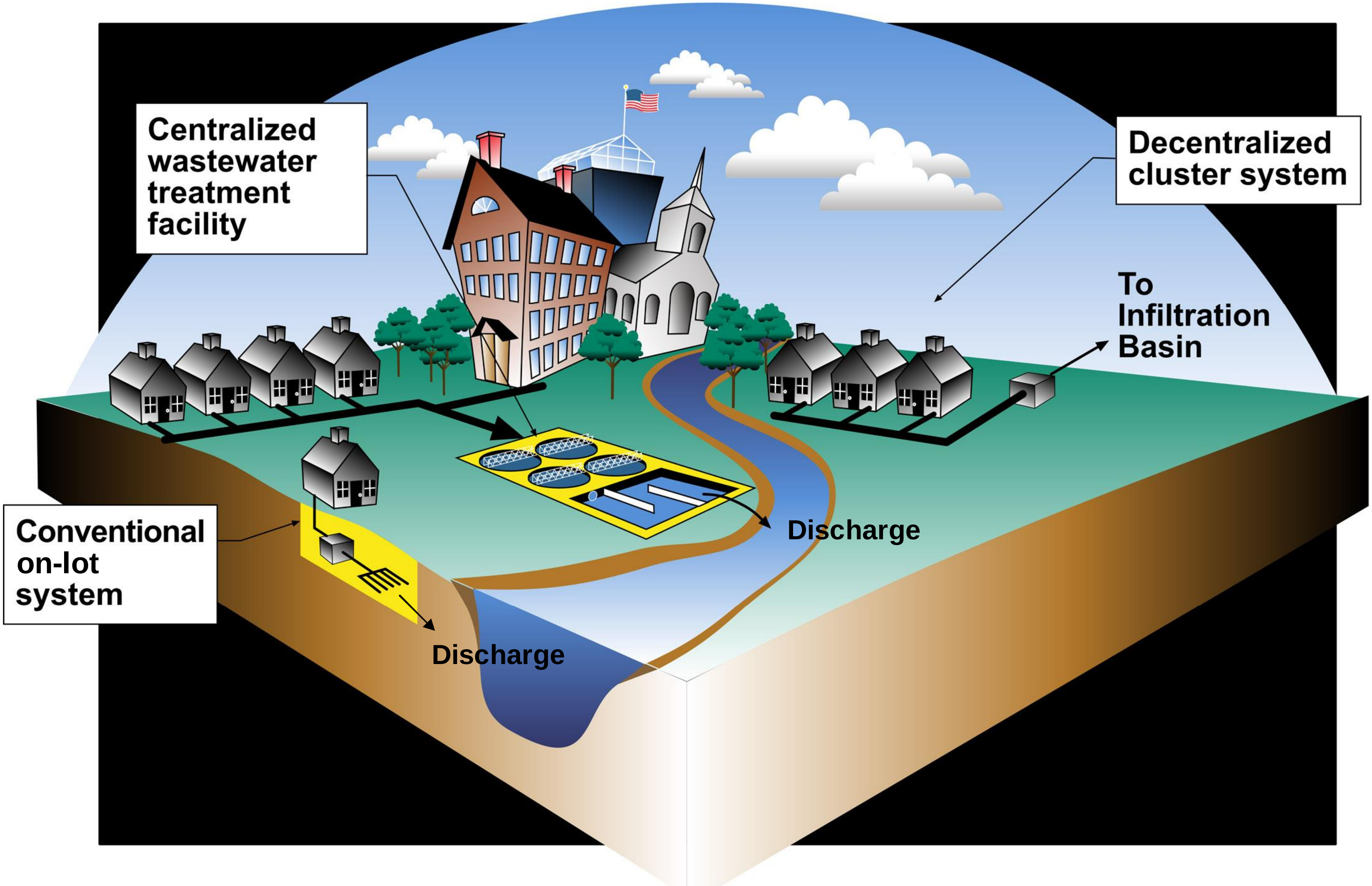

Figure 3-5. Alternative 3 – Decentralized Treatment and Continued Use of Existing WWTFs

3.3.1 Anticipated WWTF Upgrade Requirements

A number of WWTF upgrades are anticipated for this alternative. Some of the upgrades are anticipated as a result of projected 2025 changes in the permit limits for the WWTFs. The projected effluent limits for this study are included in Appendix K and Appendix L of the PFR in memos titled *Methodology for Development of Future WWTF Limits* (August 2005) and *Projected 2025 WWTF Discharge Limits* (August 2005), respectively. Other upgrades are anticipated as a result of projected increased flow and loadings to the WWTF and the inability of the various unit processes to handle the 2025 flows and loads.

Table 3-5 presents the upgrades anticipated for each WWTF under Alternative 3. The information presented in Table 3-5 is described in Section 3.1.1.

3.3.2 Anticipated Discharge and Disposal

For this alternative, the existing WWTF outfalls will be used for disposal of the effluent from each WWTF. For disposal of the effluent from the decentralized systems see Section 3.3.3.

3.3.3 Decentralized Systems

For decentralized systems, a number of sizes and configurations are possible. These systems can range from the typical single family residential on-lot septic system with a capacity of under 2,000 gallons per day (gpd), to community (shared) on-lot systems with capacities between 2,000 gpd to 10,000 gpd, and finally satellite systems which can range from 10,000 gpd to 1,000,000 gpd.

For this study, a single decentralized system size/type was assumed to accommodate the projected two-thirds increase in 2025 wastewater flow for each community with a WWTF. A decentralized treatment system with the capacity to handle 10,000 gpd was assumed. Figure 3-6 shows the typical configuration of a community on-lot system. Table 3-6 shows some of the system characteristics for a typical 10,000 gallon per day community on-lot system.

TABLE 3-6. CHARACTERISTICS OF A TYPICAL 10,000 GPD COMMUNITY ON-LOT SYSTEM

General		
	Average Daily Flow Capacity	10,000 gpd
	Number of Homes Served	20 -30
	Discharge Type	Pressure dosing system to a Soil Absorption System (SAS)
System Design		
	First Tank Volume	20,000 gallons
	Second Tank Volume	10,000 gallons
	Dosing Pump Station	Required
	Dosing Pump Station Volume	10,000 gallons of emergency storage above pump operating levels
	Dosing Cycles	4 – 8 time per day
Soil Absorption System (SAS) Requirements		
	Typical Percolation Rates	5 – 10 minutes per inch
	Typical Land Area Required	2.5 acres
	Minimum separation between high groundwater and bottom of SAS	4 ft.
	Depth of naturally occurring soil below bottom of SAS	4 ft.

Table 3-5. Alternative 3 Anticipated WWTF Upgrade Requirements.

FACILITY	Year 2004 Max Mo. Flow, MGD	Year 2025 Max Mo. Flow, MGD	Upgrades Projected	Incremental Flow Increase, MGD	Carbon Removal Upgrade Anticipated	Carbon Filtration Upgrade Anticipated	Nitrogen Removal Upgrade Anticipated	TP Removal Upgrade Anticipated	Other Upgrades Anticipated
DOVER WASTEWATER	4.57	4.87	C, TN	0.100	yes new flow	no	yes	no	IP, Pre, Dis
DURHAM WASTEWATER	1.71	1.8	TN	0.030	no	no	yes	no	IP, Pre, Dis
EPPING WATER & SEWER	0.32	0.429	C, TN, TP	0.036	yes new flow	no MBR	yes new flow	new flow chem only	Pre, Mem, Dis
EXETER WASTEWATER	3.6	3.9	AS, C, TN	0.100	all flow	no	yes	no	Pre
FARMINGTON WASTEWATER	0.52	0.57	C, TN, TP	0.017	yes new flow	no also P	yes	yes	IP, Pre, M
HAMPTON WASTEWATER	3.3	3.7	C, TN	0.133	yes new flow	yes	yes new	no	M, Dis, SH
MILTON WASTEWATER	0.08	0.09	AS, C, TN, TP	0.003	all flow	P only	yes	yes	NR
NEWFIELDS WASTEWATER	0.08	0.084	AS, C, TN	0.001	all flow	no	yes	no	NR
NEWINGTON WASTEWATER	0.18	0.2	TN	0.007	no	no	yes	no	NR
NEWMARKET WASTEWATER	1.04	1.16	AS, C, TN	0.040	all flow	no	yes	no	IP, Pre, Dis
PEASE DEVELOPMENT AUTHORITY	0.72	0.86	NR	0.047	no	no	SBR mods only	no	Dis
PORTSMOUTH WASTEWATER	8.23	8.7	AS, C	0.157	all flow	no	no	no	Dis, SH
ROCHESTER WASTEWATER	5.51	6.1	TP	0.197	no	P only	yes new	yes new flow	2nd Clarifier
ROCKINGHAM COUNTY WWTF	0.085	0.118	AS, C, TN	0.011	all flow	yes	yes	no	NR
ROLLINSFORD WASTEWATER	0.15	0.17	TP	0.007	no	P only	no	yes new flow	NR
SEABROOK WASTEWATER	1.17	1.39	NR	0.073	no	no	no	no	Air
SOMERSWORTH	1.79	1.9	C, TN, TP	0.037	yes new flow	P only	yes new	yes new flow	Pre
Totals	**33.06**	**36.04**		**1.00**					

<u>Legend</u>

C = Carbon
TN = Total Nitrogen
TP = Total Phosphorus
AS = Activated Sludge
IP = Influent Pumping
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Dis = Disinfection
Mem = Membranes
M = Metals
Air = Aeration
SH = Solids Handling
NR= Not Required

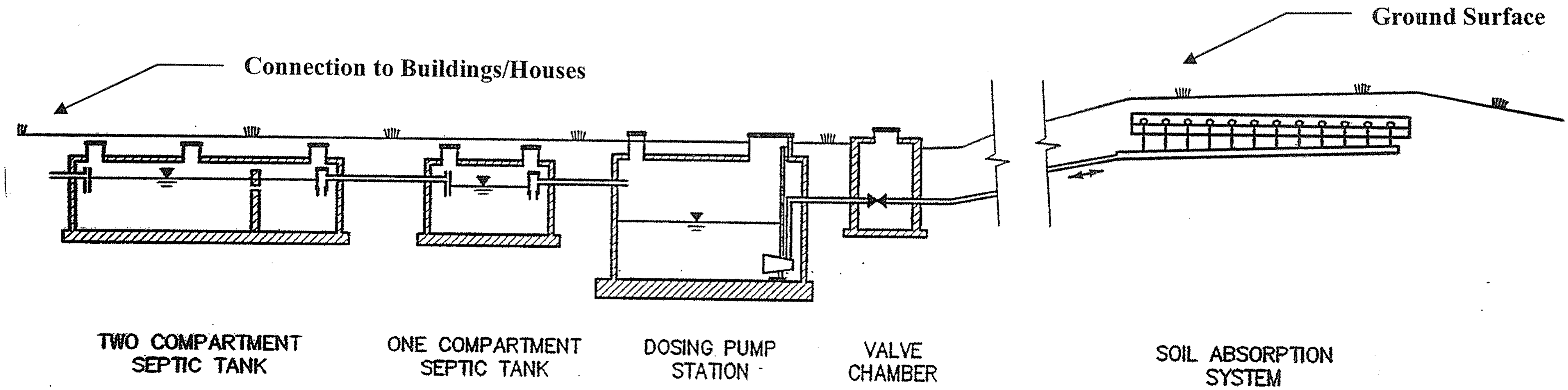

Figure 3-6. Typical Configuration of a Community On-Lot Decentralized System

For the purpose of this study, siting of these on-lot systems has not been performed. If this alternative is deemed feasible, then additional studies would need to be performed to identify the type and size of systems to be used based on the land available, ability of homes to combine discharges, and the soil characteristics adjacent to those homes.

It should be noted that these community on-lot systems are on-lot septic systems and the septic tanks need to be pumped out on a regular basis. This resulting septage would ultimately need to be disposed of at either a WWTF or another septage receiving facility.

3.4 ALTERNATIVE 4 – TREATMENT AT EXISTING WWTFs WITH LAND APPLICATION DISCHARGE

For this alternative, treatment would continue at the existing WWTFs. Treated effluent from individual WWTFs would be discharged at WWTF specific land application sites. Figure 3-7 shows the concept of this alternative.

This alternative was selected as one of the four alternatives for further study since it focuses on local land application and, thus, helps to round out the four alternatives by considering all the possible disposal options (i.e. existing receiving waters, Gulf of Maine, and land application).

This alternative assumes that all of the WWTFs will have an acceptable land application site. A two phase effort has to assess the potential availability of land application sites in the study area was conducted. The Phase 1 effort consisted of a favorable zone identification study. Phase 1 located areas that had favorable characteristics for land application while eliminating areas that did not have favorable characteristics (away from urban areas, out of well head protection areas, etc.). The Phase 1 methodology and its resulting study area maps are included in Appendix E. The Phase 2 effort consisted of a feasibility ranking of the areas identified in Phase 1. These areas were ranked to identify the relative feasibility or potential of providing a land application site in these areas. The Phase 2 methodology, its results, and WWTF specific maps are included in Appendix F.

It should be noted that based on the feasibility ranking methodology used in Phase 2, a number of WWTFs do not appear to have favorable land application sites. In a case where the Phase 2 methodology did not identify a favorable land application site in an area close to the WWTFs, the maps developed in Phase 2 were used to identify the closest land application areas possible. If an individual WWTF were to consider a land application discharge in the future, a number of additional steps would be required going forward. These include the further evaluation and identification of specific land application sites. Once identified, each discharge would require a groundwater discharge permit. Application for a New Hampshire Groundwater Discharge Permit requires the evaluation of a number of items including:

- Hydro-geologic studies of the site and the surround areas.
- A groundwater monitoring plan.
- An inventory of abutters and potential receptors.
- A hydro-geologic design and operation parameters.
- A facility plan.
- A site access and control plan.
- A contamination migration study.
- Design approval from the NHDES Wastewater Engineering Bureau.

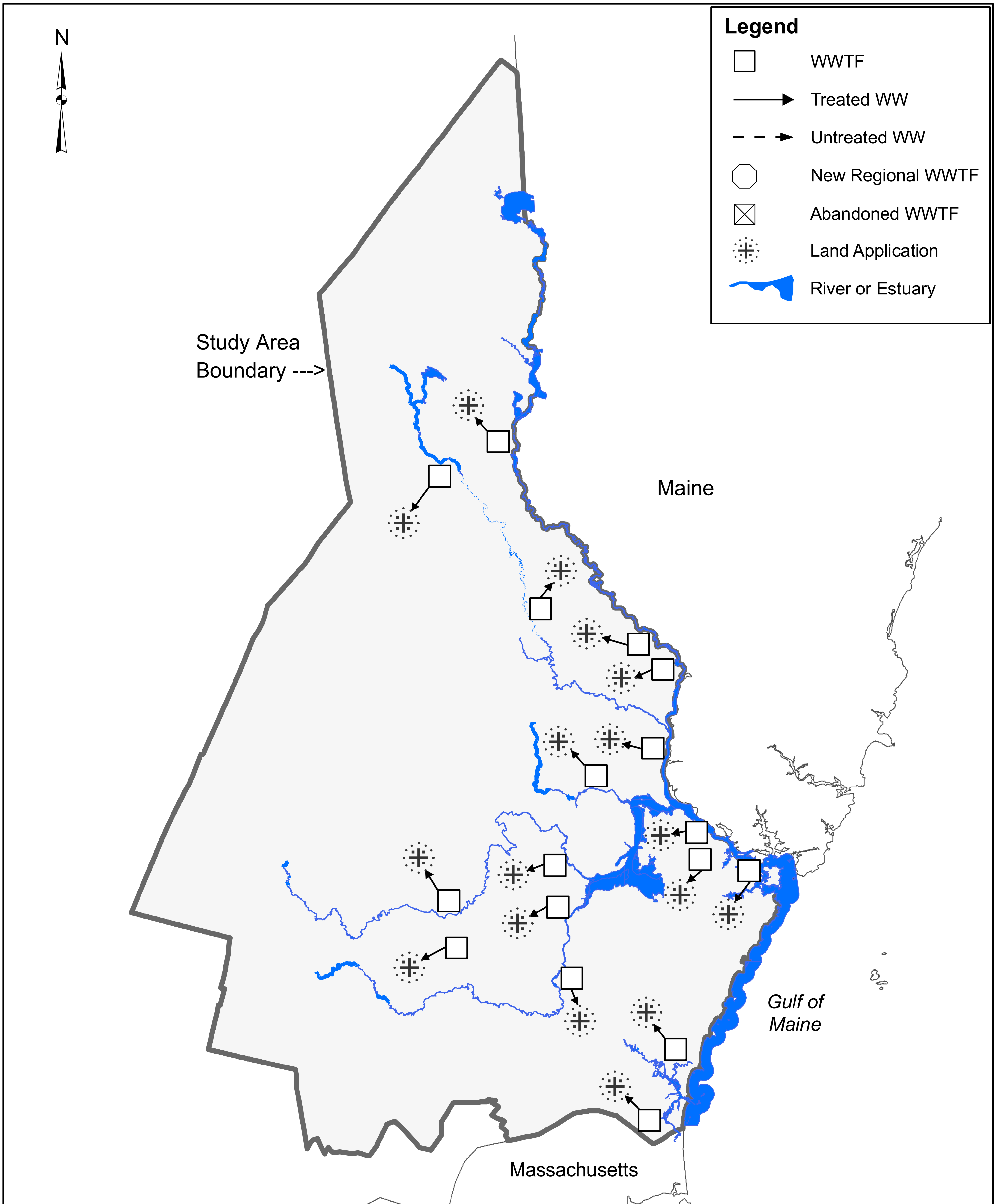

Figure 3-7. Alternative 4 - Treatment at Existing WWTFs with Land Application Discharge

3.4.1 Anticipated WWTF Upgrade Requirements

A number of WWTF upgrades are anticipated for this alternative. Some of the upgrades are anticipated as a result of projected changes in the 2025 permit limits for the WWTF due to the land application of the effluent. The projected effluent limits for this study are included in Appendix K and Appendix L of the PFR in memos titled *Methodology for Development of Future WWTF Limits* (August 2005) and *Projected 2025 WWTF Discharge Limits* (August 2005), respectively. Other upgrades are anticipated as a result of projected increased 2025 flow and loads to the WWTF and the inability of the existing unit processes to handle these future flows and loads.

Table 3-7 presents the upgrades anticipated for each WWTF under Alternative 4. The information presented in Table 3-7 is described in Section 3.1.1.

3.4.2 Anticipated Conveyance Requirements

Similar to the anticipated requirements of Alternative 2, the discharge from the 17 WWTFs will need to be conveyed to a discharge point, in this case a land application site. Similar to Alternative 2, the conveyance will be conducted via force mains. Refer to Section 3.2.2 for a discussion of the components anticipated for effluent conveyance.

Table 3-8 illustrates some of the conveyance system components anticipated for this alternative. It should be noted that these component have been sized to accommodate the average of the projected 2055 peak daily flow and the 2055 peak hourly flow. Table 3-8 shows the following information:

- Pump Stations – Number of stations anticipated and their sizes.

- Pipelines – Lengths and sizes of the various conveyance pipelines.

3.4.3 Anticipated Discharge and Disposal Requirements

For this alternative, a single land application technique was used for all 17 WWTF discharges. As the study did not locate specific land application sites, it would be difficult to determine which land application method / technology would be the most beneficial. The land application method / technology assumed to be used for this alternative was above grade, rapid infiltration basins (without under drains or recovery wells). This method / technology was used for the following reasons:

- Different land application methods require different WWTF effluent limits. In the *Preliminary Findings Report*, the WWTFs were analyzed for rapid infiltration basins effluent limits.

- Rapid infiltration basins typically require the smallest land area compared to other land application methods.

- Rapid infiltration basins can discharge year round (freezing/snow cover issues) without storage and without using both a surface water and land application discharge.

Table 3-9 shows the relative area requirements for the various WWTF effluent flow rates. The area requirements are based on the following:

Table 3-7. Alternative 4 Anticipated WWTF Upgrade Requirements.

FACILITY	Year 2004 Max Mo. Flow, MGD	Year 2025 Max Mo. Flow, MGD	Upgrades Projected	Incremental Flow Increase, MGD	Carbon Removal Upgrade Anticipated	Carbon Filtration Upgrade Anticipated	Nitrogen Removal Upgrade Anticipated	TP Removal Upgrade Anticipated	Other Upgrades Anticipated
DOVER WASTEWATER	4.57	4.87	C, TN	0.3	yes	yes	yes	no	IP, Pre, Dis
DURHAM WASTEWATER	1.71	1.8	C, TN	0.09	Filtration only	yes	yes	no	IP, Pre, Dis
EPPING WATER & SEWER	0.32	0.429	C, TN	0.109	yes new flow	no MBR	yes	no	Pre, Mem, Dis
EXETER WASTEWATER	3.6	3.9	AS, C, TN	0.3	All flow	yes	yes	no	Pre, Dis
FARMINGTON WASTEWATER	0.52	0.57	C, TN	0.05	yes	yes	yes	no	IP, Pre
HAMPTON WASTEWATER	3.3	3.7	C, TN	0.4	yes new flow	yes	yes	no	Dis, SH
MILTON WASTEWATER	0.08	0.09	AS, C, TN	0.01	All flow	yes	yes	no	Dis
NEWFIELDS WASTEWATER	0.08	0.084	AS, C, TN	0.004	All flow	yes	yes	no	Dis
NEWINGTON WASTEWATER	0.18	0.2	C, TN	0.02	Filtration only	yes	yes	no	Air, Dis
NEWMARKET WASTEWATER	1.04	1.16	AS, C, TN	0.12	All flow	yes	yes	no	IP, Pre, Dis
PEASE DEVELOPMENT AUTHORITY	0.72	0.86	NR	0.14	Filtration only	yes	yes SBR mods	no	Dis
PORTSMOUTH WASTEWATER	8.23	8.7	AS, C, TN	0.47	All flow	yes	yes	no	Dis
ROCHESTER WASTEWATER	5.51	6.1	C, TN	0.59	no	yes new flow	yes new flow	no	2nd Clarifier, Dis
ROCKINGHAM COUNTY WWTF	0.085	0.118	AS, C, TN	0.033	All flow	yes	yes	no	Dis
ROLLINSFORD WASTEWATER	0.15	0.17	C, TN	0.02	Filtration only	yes	no	no	Dis
SEABROOK WASTEWATER	1.17	1.39	C, TN	0.22	yes new flow	yes	yes	no	Dis
SOMERSWORTH WASTEWATER	1.79	1.9	C, TN	0.11	yes new flow	yes new flow	yes	no	Pre, Dis
Totals	**33.06**	**36.04**		**2.99**					

<u>Legend</u>

C = Carbon	IP = Influent Pumping	M = Metals
TN = Total Nitrogen	Pre = Preliminary Treatment	Air = Aeration
TP = Total Phosphorus	Dis = Disinfection	SH = Solids Handling
AS = Activated Sludge	Mem = Membranes	NR= Not Required

Table 3-8 Alternative 4 Anticipated WWTF Effluent Conveyance Components

Conveyance Components and Planning Level Sizing						
FACILITY	**Year 2055 Flow, MGD**	**Pipe Length, ft**	**Pipe Length, Miles**	**Year 2055 Pipe Size, in**	**Pump Stations Required**	**Pump Station Size, MGD**
FARMINGTON WWTF	0.91	1,000	0.19	8	1	0.91
MILTON WWTF	0.24	500	0.09	4	1	0.24
ROCHESTER WWTF	10.00	1,000	0.19	24	1	10.00
ROLLINSFORD WWTF	0.36	4,224	0.80	6	1	0.36
SOMERSWORTH WWTF	5.75	2,000	0.38	18	1	5.75
DOVER WWWTF	12.74	2,000	0.38	30	1	12.74
NEWINGTON WWTF	0.54	14,520	2.75	6	1	0.54
PEASE WWTF	3.15	9,000	1.70	14	1	3.15
DURHAM WWTF	5.35	13,200	2.50	18	1	5.35
NEWMARKET WWTF	2.41	9,240	1.75	12	1	2.41
NEWFIELDS WWTF	0.17	10,560	2.00	4	1	0.17
EPPING WWTF	0.70	750	0.14	8	1	0.70
ROCKINGHAM CO. WWTF	0.44	10,560	2.00	6	1	0.44
EXETER WWTF	6.75	12,672	2.40	20	1	6.75
SEABROOK WWTF	3.86	22,176	4.20	16	1	3.86
HAMPTON WWTF	8.60	18,480	3.50	24	1	8.60
PORTSMOUTH WWTF	22.00	15,840	3.00	36	1	22.00
Total	**83.94**	**147,722**	**27.98**		**17**	**83.94**

Notes:
- All flows in MGD
- All flows are the average of 2055 peak hour and peak day flows

Table 3-9 Alternative 4 Anticipated WWTF Effluent Land Application Acreage Requirements

FACILITY	Year 2004 Flow	Year 2055 Annual Ave Flow, MGD	Land Anticipated at 30 acres /MGD	Additioanl Land Anticipated for Buffers, Roads, and Ditches	Year 2055 Total Land Anticipated
DOVER WASTEWATER	2.54	3.05	91.50	4.58	96.08
DURHAM WASTEWATER	0.996	1.20	36.00	1.80	37.80
EPPING WATER & SEWER	0.197	0.23	7.02	1.05	8.07
EXETER WASTEWATER	1.86	2.30	69.00	3.45	72.45
FARMINGTON WASTEWATER	0.21	0.30	9.00	1.35	10.35
HAMPTON WASTEWATER	2.4	3.10	93.00	4.65	97.65
MILTON WASTEWATER	0.05	0.07	2.10	0.32	2.42
NEWFIELDS WASTEWATER	0.045	0.06	1.80	0.27	2.07
NEWINGTON WASTEWATER	0.13	0.18	5.40	0.81	6.21
NEWMARKET WASTEWATER	0.64	0.82	24.60	2.46	27.06
PEASE DEVELOPMENT AUTHORITY	0.38	0.66	19.80	1.98	21.78
PORTSMOUTH WASTEWATER	4.7	5.60	168.00	8.40	176.40
ROCHESTER WASTEWATER	2.9	4.10	123.00	6.15	129.15
ROCKINGHAM COUNTY WWTF	0.078	0.13	3.90	0.59	4.49
ROLLINSFORD WASTEWATER	0.09	0.13	3.90	0.59	4.49
SEABROOK WASTEWATER	0.98	1.35	40.50	2.03	42.53
SOMERSWORTH WASTEWATER	1.1	1.40	42.00	2.10	44.10
Totals	**19.30**	**24.68**	**740.52**	**42.56**	**783.08**

- For this study, 30 acres per/MGD based on 2025 average daily flow were assumed for infiltration beds not including buffer area, roads, or ditches. References indicate between 2 and 56 acres/MGD are required for rapid infiltration systems not including buffer area, roads or ditches (*Cost of Land Treatment System, EPA 1979 and Land Treatment of Municipal Wastewater EPA, Army Corps. of Engineers 1980.)*

- For buffer, road, and ditch area requirements, the following was assumed:

    - Additional 15% for flows under 0.5 MGD.

    - Additional 10% for flows between 0.5 MG and 1.0 MGD.

    - Additional 5% for flows greater than 1.0 MGD.

Table 3-10 includes some of additional assumptions and design standards typically used for rapid infiltrations basins.

TABLE 3-10. RAPID INFILTRATION BASIN DESIGN ASSUMPTIONS AND STANDARDS

	Design Criteria	**Value**
System Operation	Hydraulic Loading rate	Assumed to be 200ft/year (typical range 20-600 feet/year (6-90 meters/year.
	Wastewater application period	4 hrs to 2 weeks
	Dying period	8 hrs to 4 weeks
	Application method	Flooding
Soil Requirements	Soil Depth	At least 10-15 ft. (3-4.5 m)
	Soil permeability	At least 0.6 in/hr (1.5 cm/hr)
	Soil texture	coarse sands and sandy gravels
Basin Characteristics		
	Individual Basin Size	1-10 acres (0.4-4 ha) at least 2 basins in parallel
	Height of dikes	0.5 ft (0.15 m) above maximum expected water level